



Mac OS X Overview for UNIX Geeks

Session 104





Mac OS X Overview for UNIX Geeks

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Product Line Manager

Introduction

- A roadmap for UNIX developers new to the Mac
- What Mac developers know that you may not
- Help you get the most of the conference



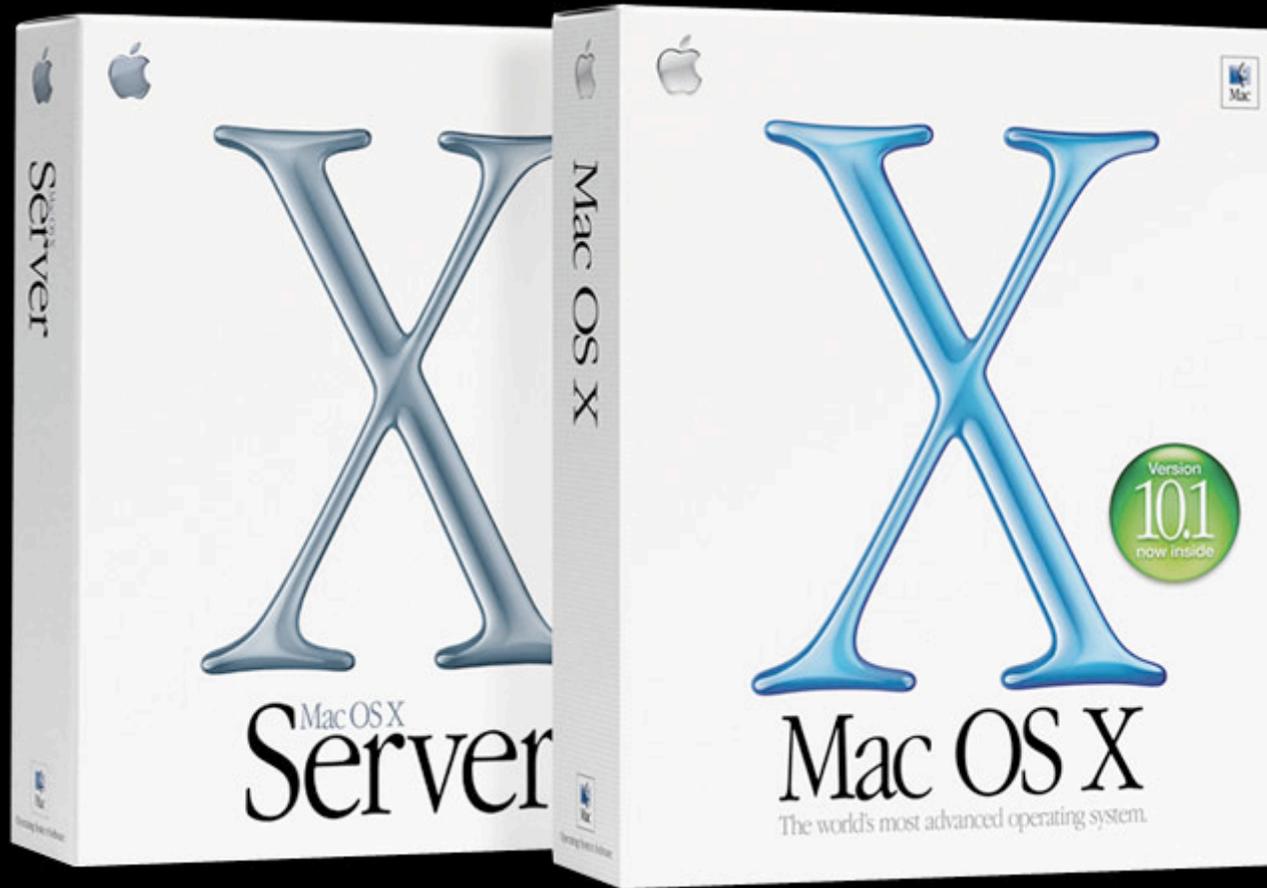
What You Will Learn

- Mac OS X Architecture
- Names and history of key technologies
- Relationship to traditional UNIX concepts
- High-level differences from prior UNIX systems
- Other conference sessions you might care about



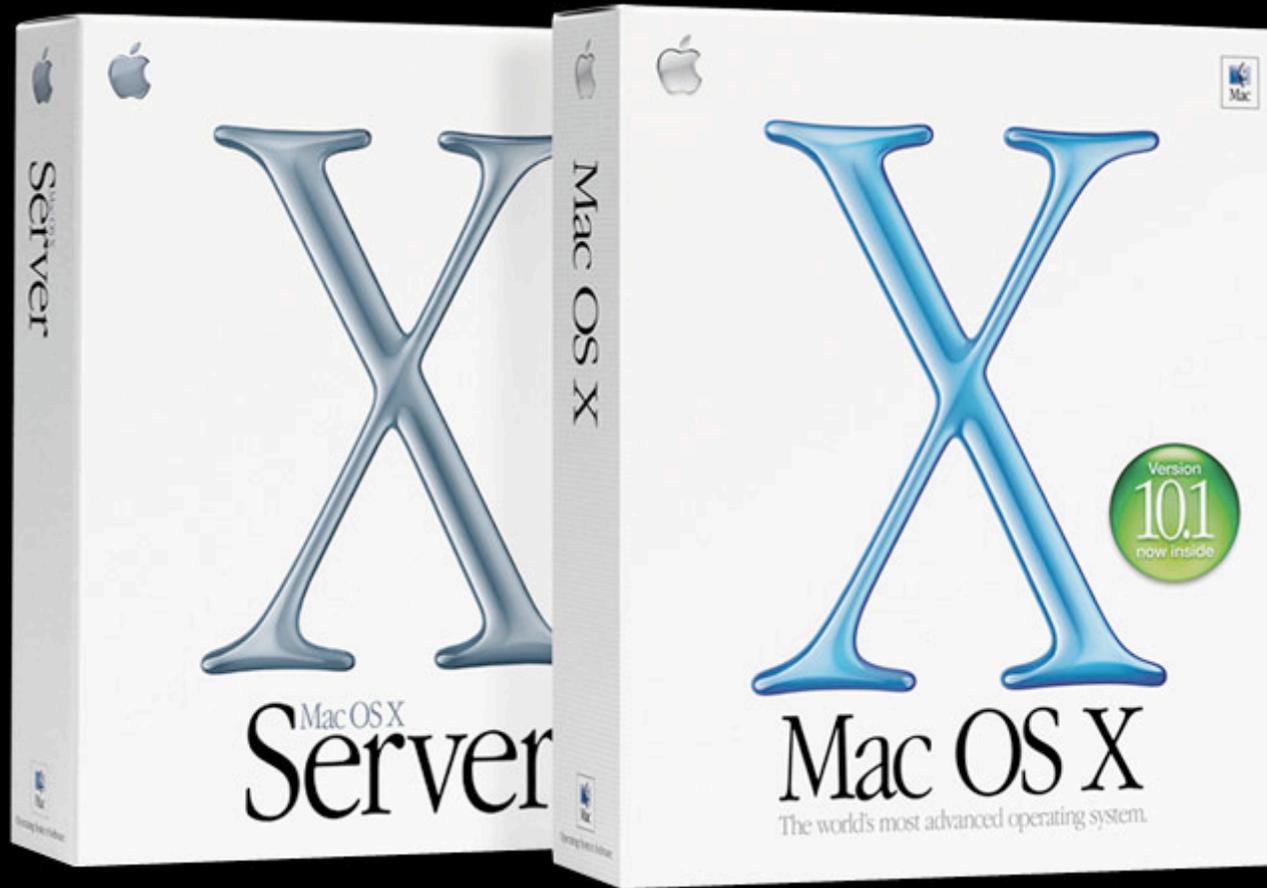


History



Power of UNIX.
Simplicity of Macintosh.





Simplicity of UNIX.
Power of Macintosh.



```

/usr/bin/login (tty1)
Processes: 44 total, 3 running, 41 sleeping... 118 threads      09:09:39
Load Avg: 1.40, 1.04, 0.86      CPU usage: 82.0% user, 18.0% sys, 0.0% idle
SharedLibs: num = 104, resident = 23.7M code, 1.69M data, 5.91M LinkEdit
MemRegions: num = 3552, resident = 101M + 7.18M private, 107M shared
PhysMem: 48.1M wired, 71.6M active, 229M inactive, 349M used, 163M free
VM: 1.66G + 48.1M      20277(0) pageins, 13699(0) pageouts

PID COMMAND      %CPU  TIME    #TH  #PRTS #MREGS RPRVT  RSHRD  RSIZE  VSIZE
984 top           6.7%  0:12.40  1    14    14    240K   308K   480K   1.37M
980 iTunes        0.0%  0:26.04  8    134   184    6.48M  9.92M  10.4M  71.1M
962 tcsh          0.0%  0:00.17  1    24    16    504K   636K   968K   5.78M
953 Microsoft    0.0%  0:00.41  1    58    89    1.75M  10.3M  3.61M  62.8M
952 Netscape 6   53.0%  2:38.99  6    82    245   17.4M  24.6M  29.8M  96.7M
951 Adobe Phot    0.7%  0:13.78  2    72    523   20.7M  28.8M  33.5M  129M
950 perl          0.7%  0:16.12  3   117   208   8.88M  36.2M  20.6M  186M
946 apache        0.7%  0:00.93  1    20   107   1.03M  2.22M  2.16M  6.25M
945 XDarwinSta    0.0%  0:00.00  1    16    13    56K    276K   244K   1.25M
944 xinit         0.0%  0:00.08  1    20    34   104K   1.16M  652K   2.98M
933 tcsh          0.0%  0:00.00  1    13    15   248K   636K   660K   5.72M
932 XDarwin       0.0%  0:00.00  1    13    15   248K   636K   660K   5.72M
920 Terminal      0.0%  0:00.00  1    68   174   2.05M  8.36M  5.59M  65.4M
918 iTunesHelp   0.0%  0:00.00  1    45    39   508K   2.72M  1.06M  38.2M
917 SystemUISe   0.0%  0:00.00  1   124   169   1.68M  6.52M  3.63M  64.1M
916 Dock          0.0%  0:00.00  1   134   594   2.45M  8.34M+ 4.86M+ 63.8M+
912 Finder        0.0%  0:21.38  3    86   212  11.1M  11.3M  15.5M  75.8M

```

- iTunes
- Play**
- Next Song
- Previous Song
- Shuffle
- Repeat Off
- Repeat All
- Repeat One
- Show In Finder
- Quit

Microsoft PowerPoint.ppt

ule of life

chromosomes

cell

gene

DNA

protein

30,000 genes code for proteins that perform most life functions

Slide 4 of 20



Building the Future

Simplicity of UNIX

- Build on BSD
- Embrace Standards
- Participate in Open Source Development

Power of Mac

- Streamline User Interface
- Deliver Killer Graphics
- Support Digital Hub



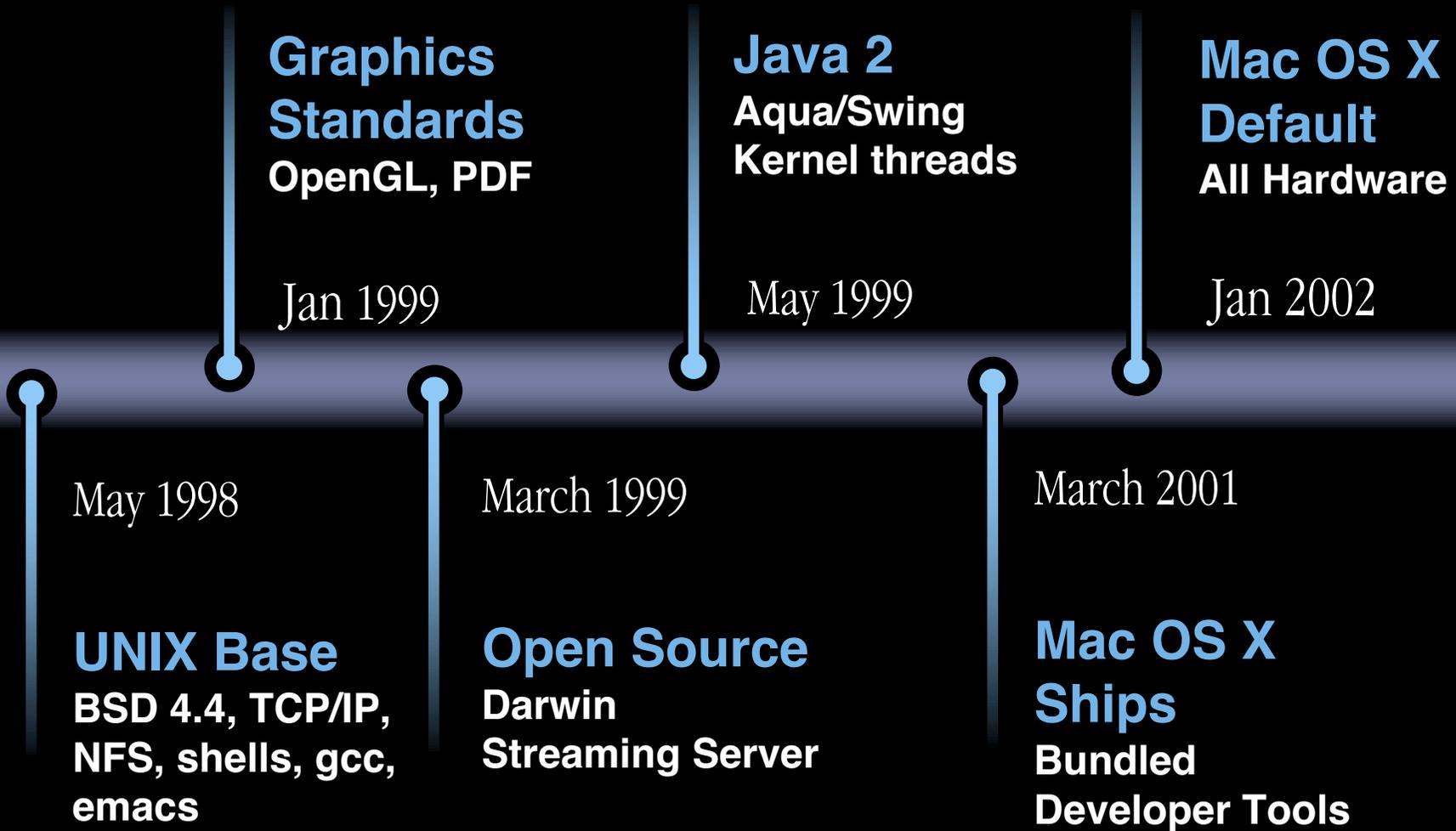
Coming Together



- Macintosh faithful
 - Consumers
 - Creative professionals
 - Small business
 - Educators, students
- UNIX lovers
 - Movie studios
 - Scientists, researchers
 - In-House developers
 - Open source community



Four Years in the Making



Rarely Seen on UNIX

- Productivity
- Games
- Digital Lifestyle
- Media Players

QUARK

meetingmaker

symantec.

metrowerks
Software Starts Here

macromedia

Adobe

Microsoft

Quicken

CREATIVE
www.SOUNDBLASTER.COM

WACOM

Connectix

ASP YR



Rarely Seen on a Mac

- Powerful Developer Tools
- Custom Science Software
- High-End Visualization
- Scalable Network Services



Alias | wavefront



Mac OS X Architecture

User Interface

Frameworks

Graphics

UNIX-Based Foundation



Modularity—The Key Enabler

- Innovate at multiple levels
- Add value while preserving compatibility
- Open Source commodity pieces
- Cleanly support legacy technologies
- Coordinate multiple small teams
- Hide complexity from users and developers



Darwin

UNIX-Based Foundation



Darwin

The UNIX-based core of Mac OS X

Command

Daemons

Libraries

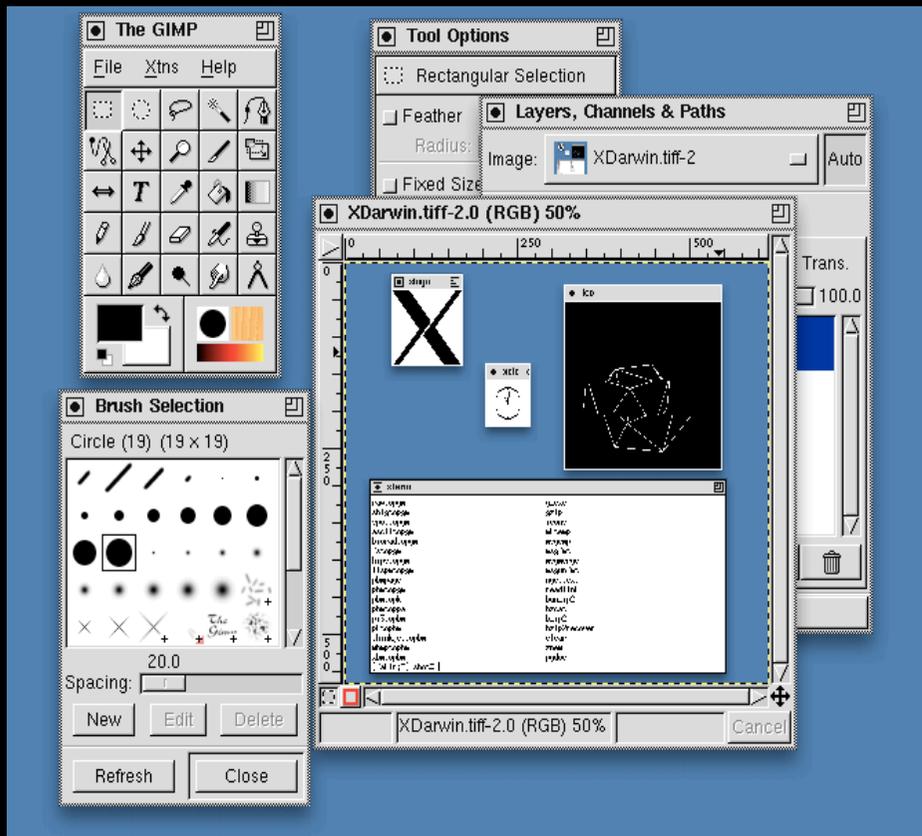
Kernel



Familiar Environment

Use your favorite utilities, tools, and languages

Available



- Toolkits:
XFree86, Qt, Tcl/Tk
- Applications:
TeX, gimp, pine
- Languages:
python, ruby, g77



Standards Based

For seamless networking and interoperability

Networking

- Ethernet
- Wi-Fi (802.11b)
- Bluetooth
- TCP/IP
- SSH
- HTTP
- FTP
- SMTP
- IMAP

Filesystems

- HFS, HFS Plus
- UFS (POSIX)
- DOS/FAT
- NFS, AFP
- SMB/CIFS
- WebDAV
- ISO 9660
(CD-ROM)
- UDF (DVD)

Directory Services

- UNIX /etc files
- LDAP
- NetInfo
- NIS
- Kerberos
- ActiveDirectory



Built-in Security

Connectivity without compromises

- Robust security policies
 - Role-based authentication (“Administrator”)
 - Network services off by default
 - No cleartext passwords for remote access
 - Automated software updates
- Comprehensive security technologies
 - CDSA encryption for passwords
 - AES-128 encrypted volumes and folders
 - Hardware and firmware-based physical security



Darwin Kernel

Combining compatibility and flexibility with innovation

- Compatibility—BSD 4.4
- Flexibility—Mach 3
- Innovation—Apple
 - Plug-n-Play drivers
 - Responsive multimedia
 - Instant Sleep/Wake
 - Seamless mobility



Open Source

Community development, enhancing the foundations

Aqua

Frameworks

Graphics

UNIX-Based Foundation

- Full Open Source development model
- Over 100,000 people using live source code
- Security and trust due to peer review
- Rapid bug fixes



Common Gotchas

- HFS + and Case sensitivity
- Almost, but not quite, POSIX
- Hey, what happened to /etc?
- Working within the framework
- Preferences vs. “dot-files”



HFS + vs. POSIX Filesystems

- Case-insensitivity
- Fast B-Tree filename searches
- Soft links implemented as “crippled” aliases
- Hard links emulated as two aliases
- Legacy Carbon API for Resource Forks
- Support Filesystem Metadata (TYPE, CREATOR)



Mostly POSIX

- Mac OS X implements most POSIX APIs
 - Improving as we sync with FreeBSD
 - Still working on some thread-signaling issues
- If you need it, and it is missing, it is a bug
- We do not plan to pass the conformance suite
- It's all Open Source if you want to help



Managing Configuration Data

- The present is the NetInfo database
- The future is “Open Directory”
 - LDAP all the way, baby
 - Full flat-file support
 - Increasing NIS support
 - Still use a local database as needed
- Until then, “nisl” is your friend



One Framework to Bind Them

- Frameworks = shared libraries + headers
- Hides implementation details from developers
- System.framework contains all the standard UNIX libraries
 - C runtime, math, curses, etc.
 - Some aliases for backward-compatibility
- Usually never need to think about it



State Your Preference

- Application defaults in `~/Library/Preferences`
- Still use traditional “.files” for UNIX tools
- Search path for multiple domains
 - User, Local, Network, System
- Uses XML “property-list” DTD
 - Easy to edit with alternate tools



Powerful Graphics

Graphics

UNIX-Based Foundation



Quartz

Innovative, PostScript-compatible 2D graphics engine



- Every application can generate and render PDF
- Fast anti-aliasing of line art and Unicode text
- Fully integrated ColorSync across screen and print
- Large numbers of built-in high-quality Roman and Asian fonts



OpenGL

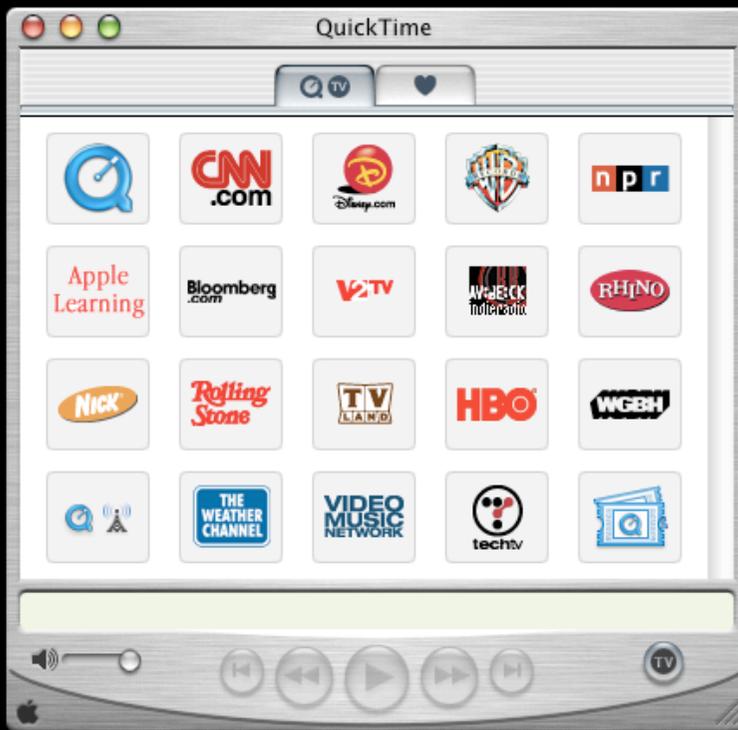
Industry-standard for 3D rendering

- State-of-the-art architecture
- Scales from games and scientific visualization to pro rendering
- Tightly integrated software and hardware support



QuickTime

The platform behind MPEG-4 standard multimedia



- Comprehensive APIs for high-quality video, universal imaging, and pristine sound and music
- Internet streaming using standard protocols and open source streaming software
- Widely distributed cross-platform application used by millions of customers



Quartz Compositor

Coordinates 2D, 3D, video for a seamless user experience



- Applications draw to window backing stores to avoid redraws
- Compositor combines window backing stores into a single image, enabling transparency and other effects
- Compositor blits directly to frame buffer between screen updates to ensure complete, seamless redraws with no tearing



What About X11?

- X11 not part of the default system
 - Does not provide the services we need
 - Available from third parties (e.g., XFree86)
 - Lets us focus on our unique value-add
- Use higher-level Aqua-compliant APIs instead
 - PDF-based Quartz
 - GLUT for OpenGL
 - Tk for Tcl, Perl, Python
 - Qt from Trolltech



Development Capability

Frameworks

Graphics

UNIX-Based Foundation



Flexible Frameworks

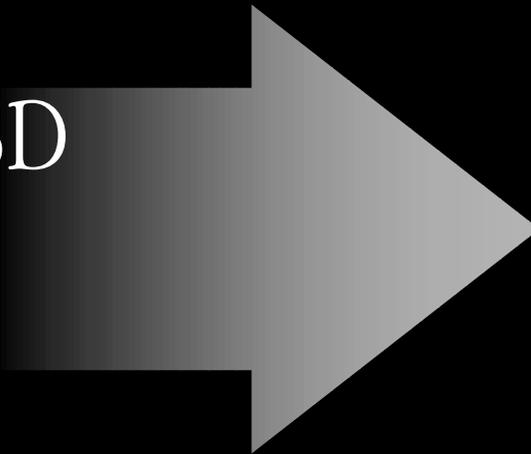
Help you port and build great applications—
no matter where you're starting from

Mac OS 9

UNIX, Linux, BSD

Java

All New



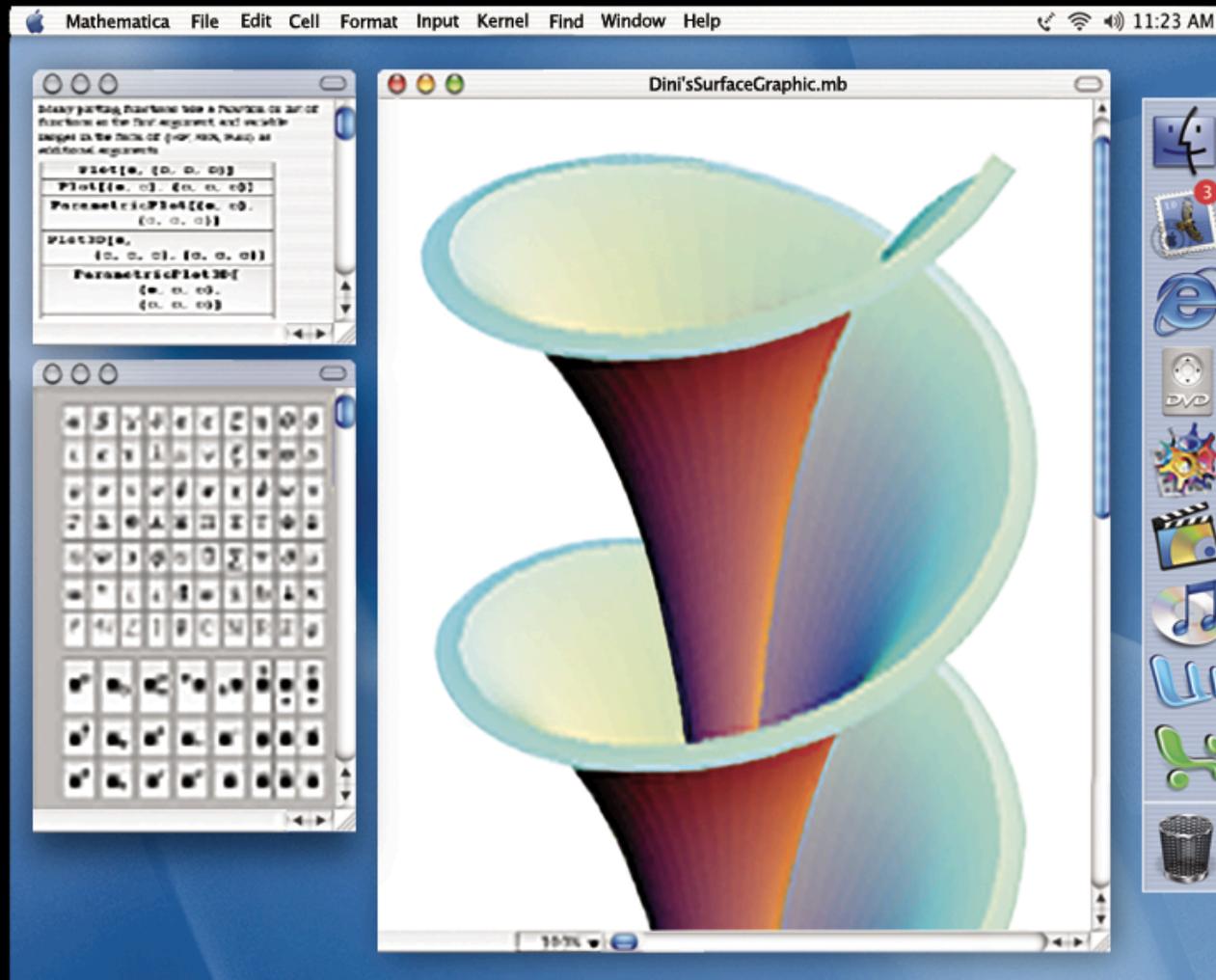
Classic

- Based on “Mac Application Environment”
 - Virtual Machine for UNIX
- “Blue Box”
 - Screen swap on Mac OS X Server 1.0
- Became shared-screen with Mac OS X v10.0
- Requires Mac OS 9 on disk
 - Can share same partition
- Good enough for legacy applications



Carbon

Optimize existing applications for Mac OS X



Carbon

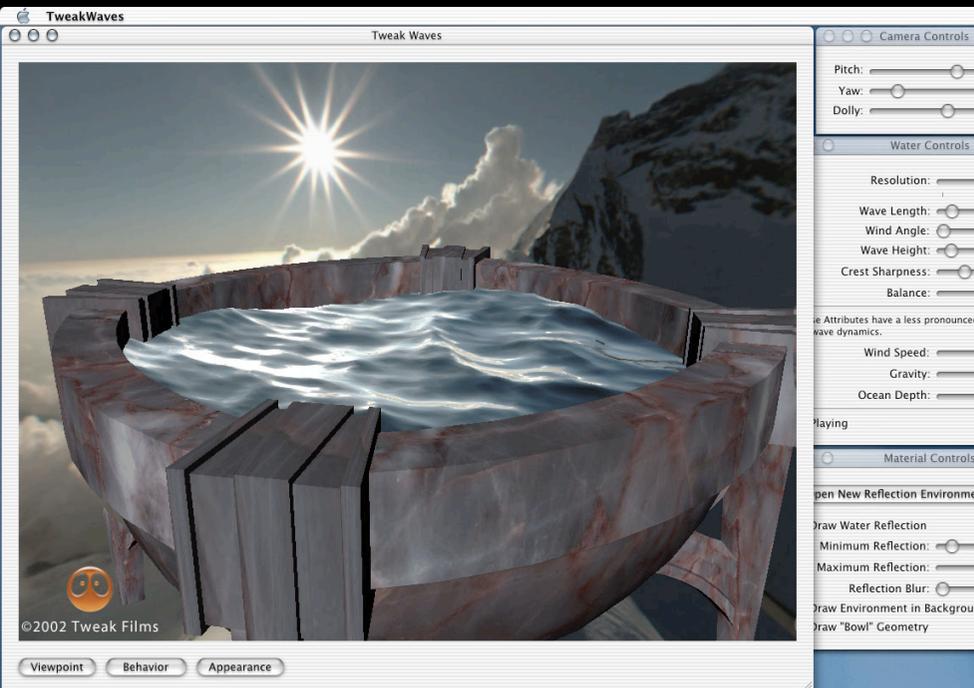
- The easiest way to bring existing Mac applications to Mac OS X
 - Modernized Mac OS 9 APIs
 - Most applications 90%+ compliant
- CarbonLib allows those same applications to run on Mac OS 9
- Used by major ISVs to get to Mac OS X
 - First UNIX-based OS with MS Office!
 - Mac front-end plus UNIX back-end (Mathematica)



Cocoa

Modern, object-oriented programming environment for building next-generation applications

After Cocoa



- Rich suite of pre-built widgets
- Easy to create Aqua front-ends
- Smoothly integrate with UNIX back ends
- Fully supported by Mac OS X tools
- Great alternative to traditional UNIX user interfaces



Objective-C

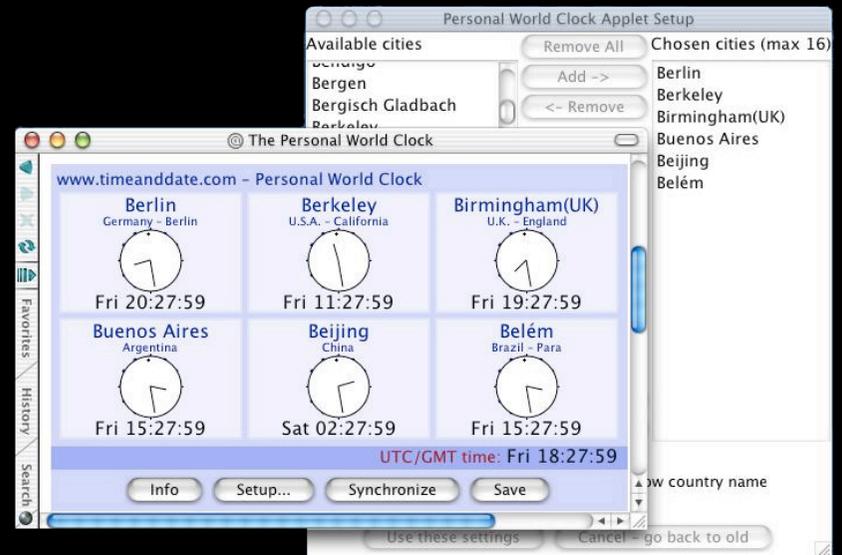
- Invented by Brad Cox, Used in NeXTSTEP
- Dynamic message dispatch (`objc_msg_send`)
- “self” pointer to class information
- Allows weak typing, can use strong typing
- Single inheritance of implementations
- “Protocol” = “interface” = “pure abstract class”
- “Godfather” of Java



Java

Take multiplatform Java applications to a new level

- Java 2 with HotSpot VM bundled with every copy of Mac OS X
- Aqua user interface for Swing applications
- Apple-invented “shared libraries” for Java
 - Reduce memory usage
 - Decrease launch times
- Accelerated 2D graphics
- Wide selection of tools and utilities



Simplicity of Mac

Aqua

Frameworks

Graphics

Darwin



Key Characteristics

- Aqua covers what would be multiple layers in X11 (toolkit, window manager, themes)
- All 'normal' usage accessible via GUI
- Services: Finder, Desktop, Dock, Menubar
- Widgets: Sheets, Taskbar, Drawers
- Customizable vs. replaceable
 - Ensures consistency of user experience and of developer targets





Developer Tools

Bundled Developer Tools

Pro-quality tools in every copy of Mac OS X

Command-line Tools

- Gcc, Gdb
- C, C++, Objective-C, Objective-C++
- javac, rmic, java, jdb
- make, cvs, lex, yacc, ar, m4
- perl, tcl, sh, csh, AppleScript, etc.

Visual Tools

- Project Builder IDE
- Interface Builder for GUI layout
- FileMerge (visual diff)
- IconComposer
- PackageManager
- ThreadViewer
- Sampler (runtime sampling)
- Pixie (pixel inspection)
- ObjectAlloc, MallocDebug



Object File Format Issues

- Binary format: Mach-O vs. ELF
 - Functionally equivalent
 - Historically divergent
 - Mac OS X development tuned for Mach-O
 - Legacy support for CFM (PEF)
- Dynamic libraries: Dyld vs. dlopen
 - Requires `#ifdef` or wrappers
 - Semantic mismatch (no `_NEXT`)





CompositeLab

- CompositeLab
 - README.rtf
 - Classes
 - CompositeView.m
 - Headers
 - CompositeView.h
 - Other Sources
 - CompositeLab_main.m
 - Interfaces
 - CompositeLab.nib
 - English
 - Images
 - BBall.icns
 - DefaultCustomImage.tiff
 - English
 - Resources
 - Credits.rtf
 - English
 - External Frameworks and Libraries
 - Cocoa.framework
 - References (Non-linked frameworks)
 - AppKit.framework
 - Headers
 - PrivateHeaders
 - Documentation
 - Reference
 - Java
 - ObjC_classic
 - AppKit.pdf
 - AppKitTOC.html
 - Art
 - Classes
 - Functions
 - IntroAppKit.html
 - Protocols
 - TypesAndConstants
 - images

This GDB was configured as "powerpc-apple-macos10".
 tty /dev/ttyp2
 run
 [Switching to thread 1 (process 939 thread 0x1603)]
 (gdb)

Stopped at breakpoint.

Thread-1

#	Frame
0	-[CompositeView initWithFrame:]
1	-[NSCustomView nibInstantiate]
2	-[NSIBObjectData instantiateObject:]
3	-[NSIBObjectData nibInstantiateWithOwner:topLevelOb
4	-[NSRTFReader dealloc]
5	+ [NSBundle(NSNibLoading) _loadNibFile:nameTable:w
6	+ [NSBundle(NSNibLoading) loadNibFile:externalName
7	+ [NSBundle(NSNibLoading) loadNibNamed:owner:]
8	NSApplicationMain
9	main
10	_start
11	start

Variable	Value
Arguments	
self	0x238470
_cmd	0x70000010
rect	
Locals	
_objc_super	{...}

Print Description to Console

```
CompositeView.m:92 : -initWithFrame:
  [(result = [[NSImage allocWithZone:[self zone]] initWithSize:dRect.size])
  addRepresentation:[[[NSCustomImageRep alloc] initWithDrawSelector:@selector(drawResult:) delegate:self]
  autorelease]];
  [result setBackgroundColor:[NSColor clearColor]];

  // Set the default operator and source picture. No need to set the default
  // colors; these are read from the .nib file when the outlets to the wells
  // are established.
  operator = NSCompositeCopy;
  sourcePicture = TrianglePicture;

  // Tell the application that alpha should be allowed in the color panel
  // and dragged colors. Most apps do not want to bother with this.
  [NSColor setIgnoresAlpha:NO];

  // Finally, register for dragging colors and files.
```

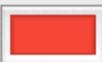
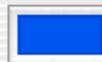
CompositeLab

Mode

- Copy
- Clear
- Sover
- Dover
- Sin
- Din
- Sout
- Dout
- Satop
- Datop
- Xor
- PlusD
- PlusL

Source Destination Result

Colors

Source  Destination  Background 

Source Picture

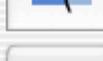
Triangle Circle Diamond
 Heart Flower Custom

Cocoa-Views

Text

Button 

Switch 

Radio  Radio 

Field1:

Field2:

Label Font Text
Small System Font Text
System Font Text

CompositeLab.nib - MainMenu

CompositeLab Edit Font Text Window

- Undo ⌘Z
- Redo ⇧⌘Z
- Cut ⌘X
- Copy ⌘C
- Paste ⌘V
- Clear
- Select All ⌘A
- Colors... ⇧⌘C
- Find ▶
- Spelling ▶
- Speech ▶

CompositeLab.nib

Instances Classes Images Sounds

File's Owner 

First Responder 

MainMenu 

CompositeWi... 

Font Manager 

CompositeView (Custom) Info

Connections

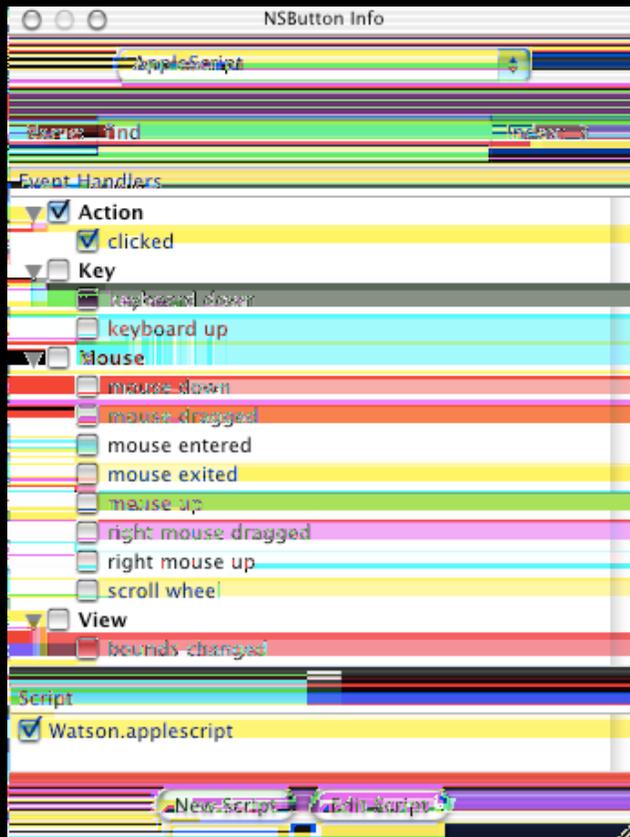
Outlets

- backColorWell
- destColorWell
- menu
- nextKeyView
- sourceColorWell
- sourcePictureMatrix

Source	Destination
backColorWell	NSColorWell (0)
destColorWell	NSColorWell (0)
sourceColorWell	NSColorWell (0)
sourcePictureMatrix	NSMatrix (0)

AppleScript Studio

Create rich, complete applications entirely in AppleScript

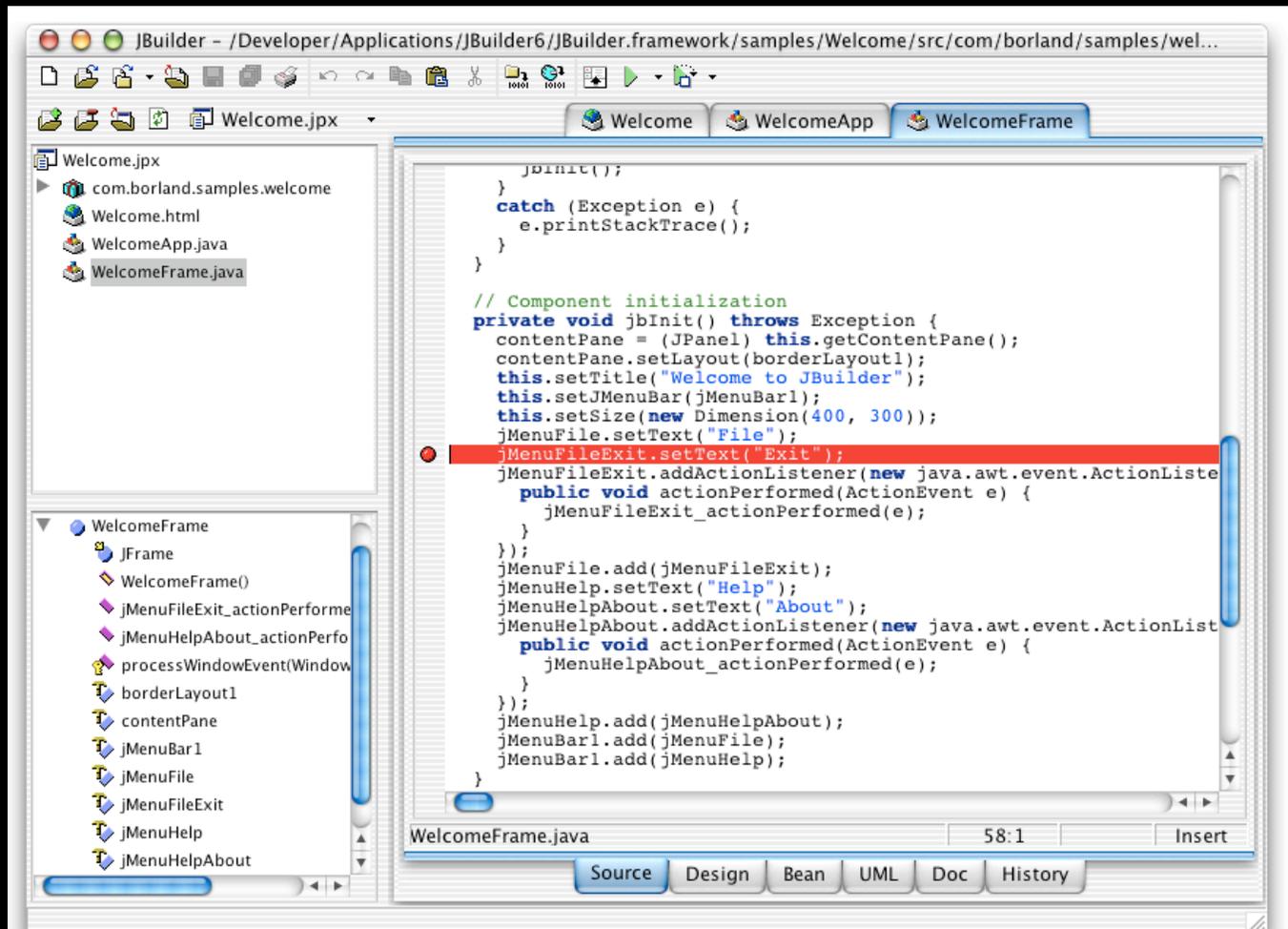


- Rich Aqua widgets
- Cocoa frameworks
- UNIX scripts
- Remote AppleEvents
 - Application control
 - Network workflows
 - Web services
- 'osascript' from command-line



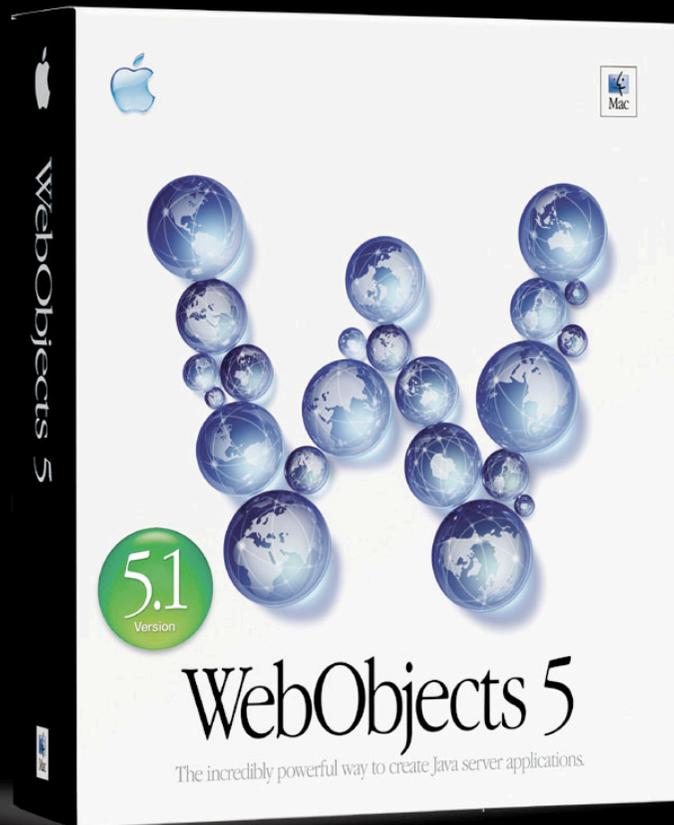
Third-Party Tools

Easy transition for cross-platform Java, Basic, C++



WebObjects 5.1

Everything you need to create three-tier applications



- Integrated development environment
- Automated database mapping
- Streamlined page layout
- Graphical user interface design
- Easy Java deployment to J2EE or J2SE servers



Darwin Documentation

UNIX documentation specific to Mac OS X

- man pages
 - Viewable from Project Builder and Terminal (shell)
- Parts of “Inside Mac OS X: Kernel Programming”
- “Bringing UNIX Applications to Mac OS X”

Documentation > Darwin

developer.apple.com/techpubs/macosx/Darwin/index.html



Tools Documentation

Mac OS X documentation relevant for UNIX

- Developer Tools
 - Compiler
 - Assembler
 - Preprocessor
 - Mach-O runtime architecture

Documentation > Mac OS X > Developer Tools

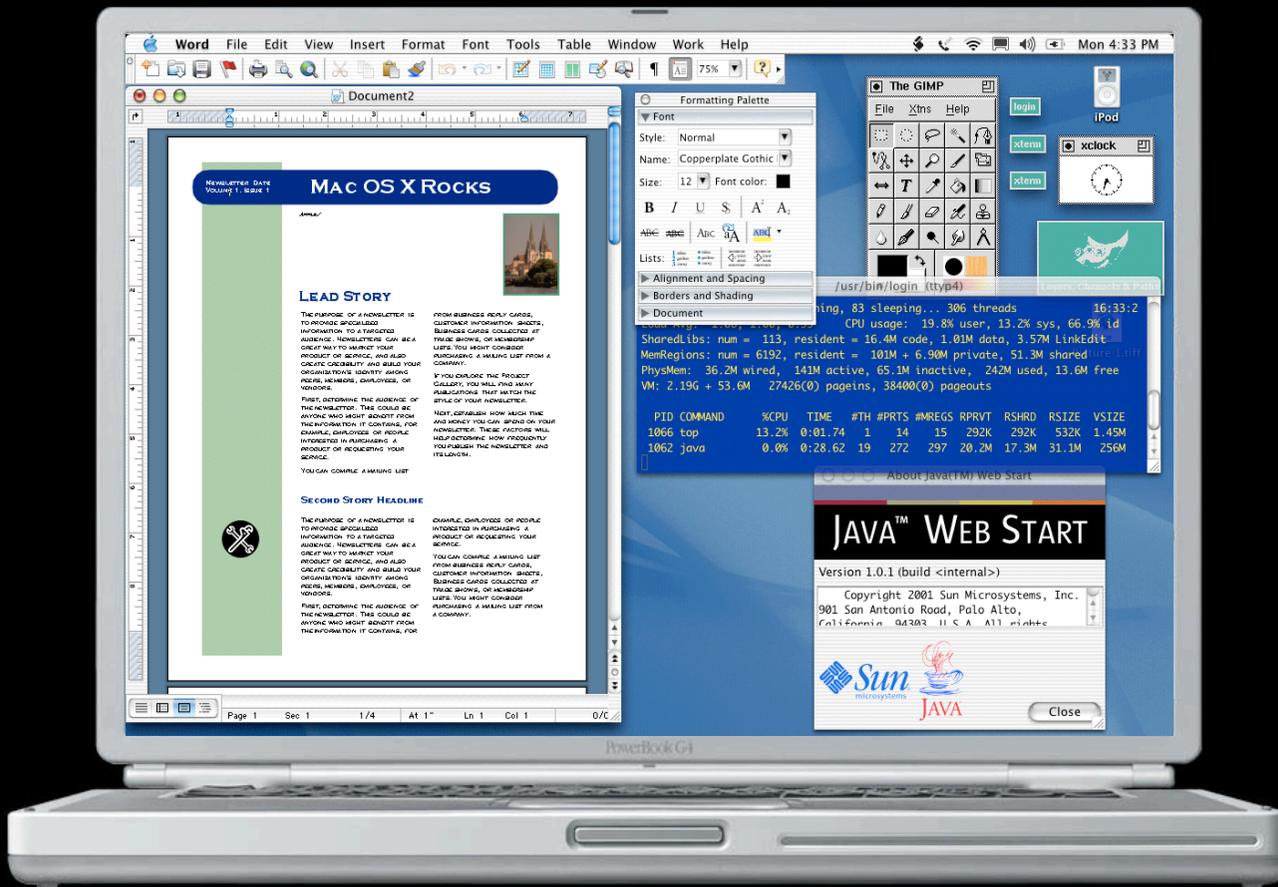
developer.apple.com/techpubs/macosx/DeveloperTools/devtools.html





Summary

The Dream Machine



- Mainstream UNIX
- Mac Interface
- Microsoft Office
- Standard Java 2
- Free Tools
- To go!



Roadmap

**404 Tailoring Java Applications
for Mac OS X**

Room J
Tue., 5:00pm

006 Tim O'Reilly on Mac OS X

Hall 2
Wed., 12:30pm

902 AppleScript Studio Intro

Civic
Wed., 3:30pm

**903 Exploring the Project
Builder IDE**

Hall 2
Wed., 5:00pm



Roadmap

302 Cocoa API Techniques

Hall 2
Thurs., 9:00am

904 Using Interface Builder

Hall 2
Thurs., 3:30pm

813 Directory Services

Room C
Thurs., 3:30pm

**907 Compiler Developments
at Apple**

Room J
Fri., 10:30am



Who to Contact

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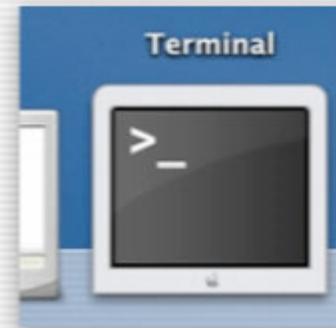
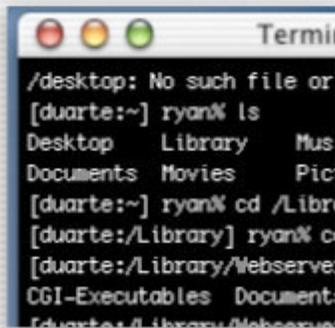
For More Information

- O'Reilly, *Mac OS X: The Missing Manual*
- UNIX Developer Information
<http://developer.apple.com/unix>
- Mac OS X UNIX Downloads
http://www.apple.com/downloads/macosx/unix_apps_utilities/
- Other places
 - unix-porting@lists.apple.com
 - www.stepwise.com
 - apple.slashdot.org





Q&A



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<http://developer.apple.com/wwdc2002/urls.html>

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